Is use of hospital services a proxy for morbidity? A small area comparison of the prevalence of arthritis, depression, dyspepsia, obesity, and respiratory disease with inpatient admission rates for these disorders in England

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Abstract

Objectives – To examine the relationship between specific types of morbidity, measured by validated survey questions, and hospital service use and mortality to see if the latter two could act as a proxy in health needs assessment, health service planning, and resource allocation in a typical health district.

Design – A postal questionnaire was used to provide information about depression, digestive disorders, musculo-skeletal disorders, obesity, respiratory disease, and hip and knee pain. The questions were from survey instruments that have been widely used to derive information about these conditions. The relationships between the prevalence of these specific types of morbidity and appropriate admission and mortality rates were explored using linear regression and Pearson correlation analysis.

Setting – The population of Rotherham health district, England.

Subjects – A simple random sample of the residents of each of the 22 electoral wards in Rotherham health district.

Results – Responses were obtained from 78% of the 5000 sampled (82% after excluding people who had moved house or died). Significant, positive correlations were found between the prevalence of respiratory disease and the hospital admission and mortality rates for respiratory problems ($r=0.68$, $p<0.01$ and $r=0.54$, $p<0.01$) and the prevalence of depression and the admission rate for depression ($r=0.52$, $p<0.05$). No such relations were found for digestive disease, musculo-skeletal disease, and obesity. For the conditions examined here, hospital service use was a more useful measure than mortality.

Conclusions – Only two diseases (respiratory disease and depression) out of the seven diseases or procedures investigated showed a positive correlation between hospital admission and disease prevalence. But even for these two, the correlations explained less than 50% of the variance. Caution must be exercised when hospital service use is being considered as a proxy for morbidity.

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In order to plan for health service developments, health authorities require as accurate an assessment of the health needs of their local populations as possible.^{1,2} Routine information on health, however, is often inaccurate and may be incomplete and insufficiently comprehensive.^{2,3} Death certification, which provides a better source of data, is frequently used,⁴ but such mortality data may be inadequate or inappropriate for deploying health service resources more rationally and equitably.^{5,6} This is especially true for conditions which give rise to substantial amounts of ill health but only rarely to death. Hospital inpatient service use is another very widely used information source. It has the disadvantage, however, that there may be many who could benefit from health services but, because they are not currently receiving them, are consequently not represented.⁵ In spite of these disadvantages, use of hospital services is frequently suggested as a proxy measure⁷ and, indeed, resources are often distributed on this basis.

In measuring the health of whole populations, direct-mailed questionnaires have frequently been used.⁸ Their advantages are that they are a relatively cheap mode of investigation which go a long way towards removing subjectivity. It is important, however, to remember that the results of such surveys are reliable only when relatively high response rates are achieved.⁸

Many survey based studies, and their associated questionnaires, such as the Nottingham Health Profile,^{9,10} are designed only to give a global picture of an individual's health. Accordingly, the aim of the present study was to compare information from a survey based on well validated questions on *specific* areas of morbidity with hospital service use and with mortality statistics. We chose, therefore, to explore individual areas of major morbidity where routine information is difficult to interpret. These were: depression, digestive disorders, musculo-skeletal disorders, obesity, respiratory disease and, specifically, hip and knee pain. They were picked because for each of them there were validated direct-mailed questions and comparable survey results from other communities available.

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Table 1 The number and source of the questions used in the postal questionnaire.

Clinical area	No of questions	Source
Depression	7	The Hospital Anxiety and Depression Scale ¹²
Digestive disorders	4	Postal questionnaire on dyspepsia ¹³
Musculo-skeletal disorders and hip and knee pain	4	Arthritis and Rheumatism Council: Epidemiology Research Unit Questionnaire (Silman, personal communication)
Obesity	4	Postal questionnaire on sports injuries ¹⁴
Respiratory disease	10	Medical Research Council's Committee on Environmental and Occupational Health: Questionnaire on respiratory symptoms ¹⁵
Total	29	

In a single health district people from different areas within its boundary often have noticeably different levels of health.¹¹ However, they all usually have the same hospital services available to them. In planning equitable health care provision we, therefore, need to know whether hospital service use is greatest in those areas in which morbidity is the highest. This paper examines this question and seeks to test the hypothesis that routinely collected hospital activity data can act as a proxy for morbidity in health needs assessment, service planning, and resource allocation in a typical health district.

Methods

SETTING

Rotherham District Health Authority is coterminous not only with the metropolitan council but also with the family health services authority boundaries. It has an estimated population of 255 000, with 196 000 on the electoral roll. There are 22 electoral wards with a mean number of 9000 on the electoral roll, but this ranges from 6000 to 13 000.

SAMPLING PROCEDURE FOR THE MORBIDITY SURVEY

The sampling frame was the 1990 electoral roll for Rotherham Metropolitan Council. The total sample size was 5000, and a simple random sample, proportional to the population of each ward, was taken for each of the 22 electoral wards. The questionnaire and the direct-mail method were piloted on 600 respondents. A response rate of 80% was achieved after one reminder and the results of the pilot were included with those of the full survey. For the purpose of describing local differences in the prevalence of conditions, the electoral wards were grouped into nine larger localities. Each was a recognised local community as well as being compatible with social service and community unit areas.

Power calculations based on standard statistical assumptions show that a population

survey based on the size of these localities (around 430 responses per locality) will estimate a prevalence of 10% with a 95% confidence interval of 7.25%, 12.75%. In analysing correlations between routine data and the prevalence of conditions, however, the estimates of prevalence for individual electoral wards were used. Not only were differences in prevalence greater between wards than between localities, but also the use of ward based estimates ensured that the correlation analysis made maximum use of the information available. Any loss of accuracy in estimating the correlation coefficients because there were smaller numbers in the ward samples was compensated for by the increase in the number of correlation pairs available.

QUESTIONNAIRE

The questionnaire was set out on four sides of A4 sized paper (an A3 sheet folded in half). It covered five clinical areas in which routine information on morbidity is lacking: depression, digestive disorders, musculo-skeletal disorders, obesity, respiratory disease, and, specifically, hip and knee pain. The number of questions in each area and their sources are shown in table 1.

The questionnaire was designed so that the questions could be considered in simple consecutive order and it could be easily completed. Envelopes were addressed to named people on the electoral roll and the name was also used to address the person on the covering letter. These letters were on health authority headed note-paper and signed by the director of public health. The survey was carried out in February 1991, and the questionnaires were posted on a Thursday so that they could be completed over the weekend. A reply paid envelope was used for the first mailing, and a stamped addressed envelope for the reminder. Press releases were sent at the time of the survey to all local media, members of parliament, general practitioners, and local councillors.

HOSPITAL USE AND MORTALITY DATA

Hospital admissions were measured as consultant episodes for relevant primary and other diagnoses or procedures. Numbers of episodes for hospitals within the Trent health region were obtained by electoral ward of residence from the regional patient information system. These data were derived from Körner returns for the period covering the five financial years 1987/8–1991/2. The ICD9¹⁶ or OPCS-4¹⁷ codes that were used to define depression, digestive disease, musculo-skeletal disorders, obesity, respiratory disease and major joint replacements are shown in table 2. Relevant mortality data were also obtained from OPCS death tapes for the same period.

ANALYSIS

The responses to the survey questions were translated into assessments of morbidity. The definitions of these are listed below:

Table 2 ICD9¹⁶ and OPCS-4¹⁷ codes used to define hospital use for the conditions studied.

Condition	ICD9 or OPCS-4 codes
Depression	ICD9: 296.1, 296.3, 298.0, 300.4, 309.1, 311
Digestive disease	ICD9: 150–151, 157, 530–537
Musculo-skeletal disorders	ICD9: 710–739
Obesity	ICD9: 278
Respiratory disease	ICD9: 162, 490–496
Hip replacements	OPCS-4: W37–W39
Knee replacements	OPCS-4: W40–W42

Table 3 The variation in the prevalence of different morbidities by age and sex.

	Age (y)						All ages	
	18-34		35-54		55+		Men	Women
	Men	Women	Men	Women	Men	Women		
Depression	8.7	10.1	12.7	15.0	22.1	25.8	14.7	17.4
Digestive disease	37.2	33.8	37.3	38.0	32.1	36.6	35.4	36.2
Musculo-skeletal disorders	26.9	28.2	40.1	47.5	51.7	63.8	40.0	47.6
Obesity	6.8	7.0	10.9	13.7	9.4	13.0	9.1	11.5
Respiratory disease	22.1	23.0	27.6	21.5	42.3	31.4	31.0	25.5
Hip pain	3.4	3.8	7.9	10.5	13.2	18.4	8.3	11.3
Knee pain	19.2	12.1	24.1	20.3	31.3	36.0	25.1	23.5

Depression
Depression was defined as a score of 8 or more on the depression element of the Hospital Anxiety and Depression Scale. This definition, therefore, includes both depression and borderline depression.

Digestive disorder
This was defined as a positive response to any of the questions about dyspepsia, heartburn, or indigestion occurring in the previous six months.

Musculo-skeletal disorder
This was defined as a positive response to any of the questions on joint swelling or painful joints in the absence of injury.

Obesity
Subjects with a body mass index (weight (kg) × height (m) squared/100) of 30 or more were categorised as obese.

Respiratory disease
Respiratory disease was defined as a positive response to questions on either asthma or chronic bronchitis.

Prevalence of different morbidities in localities in Rotherham (medians and ranges). Median (range) values are as follows: depression 16.2% (10.7-25.0); digestive disorders 36.8% (30.0-41.5); musculo-skeletal disorders 44.0% (35.8-53.3); obesity 9.2% (6.2-13.7); respiratory disease 28.6% (14.3-42.0); painful hips 7.6% (4.2-18.8); painful knees 23.4% (17.7-37.0).

Painful hip or knee
Responses to specific questions on painful knees or hips were used directly.

In order to estimate best the prevalence of the morbidities which vary with age and sex in each ward the ward samples were adjusted to reflect the age-sex composition of the underlying ward populations as measured by the 1991 OPCS population estimates. The adjustment was done using six strata of approximately equal size comprising men and women aged 18 to 34 years, 35 to 54 years, and 55 years and over. The adjusted ward sample sizes were kept the same as the actual samples. The age-sex specific morbidity prevalences were then applied to the adjusted samples to produce ward estimates of prevalence.

The relationships between the estimated ward prevalences of each of the various morbidities and both the hospital admission rates and the mortality rates were examined using scatterplots and Pearson's correlation coefficient, after testing for violation of the assumptions for regression. Admission rates were calculated using numbers of consultant episodes as the numerator and the 1987/8-1991/2 average ward populations as the denominator. Data were not standardised as differences in distribution of sexes and ages between wards should affect both sets of rates equally.

Results
The total response rate was 78% (3877 of 5000). After exclusion of those who had moved house or died, the response rate became 82% (3877 of 4752). The response rate before sending the reminder was 63% (2972 of 4752). Final response rates varied between individual wards from 66.9% to 89.9%, but in 19 of the 22 wards the proportion who responded was over 75%. The response rates were lower in the more underprivileged wards (correlation coefficients for response rate versus unemployment and Jarman score were -0.74 and -0.84 respectively, $p < 0.01$).

The variation in the seven types of morbidity in relation to age and sex is shown in table 3. There are appreciable age and sex differences in general, apart from for digestive disease. The age and sex differences for the other conditions are as expected. Because of these differences we decided to adjust the prevalences of all the morbidities to reflect the age-sex composition of the underlying ward populations.

The figure shows a summary of the main results for the estimated prevalence of each of the five main conditions. Musculo-skeletal disorders show a particularly high prevalence, with a median of 44% among the nine localities. Even in the locality with lowest prevalence it was still over 35%.

The prevalences of depression, respiratory disease, and digestive disorders were all high but again there was considerable variation between localities. Thus, for example, there was a threefold range of respiratory disease prevalence from a minimum of 14% to a maximum of 42% in the worst locality.

Table 4 Correlation coefficients (*r*) for comparisons between prevalence of disease as determined by the morbidity questionnaire and rates of hospital admissions and mortality for specific conditions.

Morbidity measure from questionnaire	Admission <i>r</i>	Mortality <i>r</i>
Depression	0.52*	NA
Digestive system disorders	0.13	0.15
Musculo-skeletal disorders	0.30	0.41
Obesity	−0.14	NA
Respiratory disease	0.68†	+0.54†
Painful hips	Inverse relation‡	NA
Painful knees	0.14	NA

* $p < 0.05$; † $p < 0.01$.
‡ Regression assumption of normality violated. Transformation found a statistically significant inverse relation.
NA = None or insufficient deaths to calculate a correlation coefficient.

CORRELATIONS

The assumptions for regression were not violated in any of our correlation analyses, apart from hip pain where an inverse relation was found.

Pearson’s correlation coefficients between the morbidity measures and hospital use and deaths are shown in table 4. Over the 22 electoral wards only respiratory disease and depression showed a large enough positive correlation to be statistically significant between admission rates and prevalence as determined by the morbidity survey ($r = 0.68$, $p < 0.01$ and $r = 0.52$, $p < 0.05$). Even in these cases the size of the correlation coefficients shows that much of the variance in prevalence between wards remains unexplained by differences in the hospital use ($r^2 = 46\%$ for respiratory disease and 27% for depression). For the other conditions the correlation coefficients were mostly positive but were too small to be significantly different from zero. In the case of hip replacement rates there was actually a statistically significant inverse relation between the prevalence of hip pain and admission rates. Thus, those wards with high hip replacement rates had low hip pain prevalences and vice versa.

Numbers of deaths over the period studied were too small for correlations between mortality and depression, obesity or joint replacements to be explored. Once again, only for respiratory disease was there a significant positive correlation between morbidity as determined by the survey and mortality rate. This correlation was not as high as that with hospital admission rate.

Discussion

Researchers from the USA and elsewhere have consistently found that hospital admission and surgical procedure rates generally vary appreciably across geographical areas.^{18–21} The major determinants of these rates were the supply of hospital beds and specialist physicians and surgeons and variations in clinical practice. Ill health has not been found to be a major determinant in the few instances where this has been explicitly studied.^{21–23}

A British review addressing the question of whether hospital use can be used as a measure of health need concluded that hospital utilisation data are flawed as a proxy for health needs because of variations in the supply of services and in professional decision making.²⁴ Supply

of beds is the main determinant of admission rates at both inter-regional and inter-district level. Only for a small number of conditions which are easily diagnosed and for which there is a consensus on treatment (for example, acute myocardial infarction, gastrointestinal haemorrhage) does hospital use seem to relate clearly to morbidity.¹⁹ By contrast, however, the premise of Royston *et al* is that at a sufficiently small area level, populations compete for the same exogenous supply of services and that their different relative use of services reflects variations in their relative need.⁷

Not all the conditions considered are likely to lead to hospital admission. A priori it would have been expected that respiratory symptoms and depression would have been more likely to lead to hospital admission with dyspepsia, hip pain, knee pain, and musculo-skeletal disorders less so. It would be unusual for obesity to lead to admission. The results reported here, however, show that at small area level there is poor correlation between the use of hospital services and the prevalence of most of the conditions determined from the morbidity questionnaire. Such surveys, even using validated questions, are themselves only a proxy measure of health but do have the advantage that they sample the whole population, not just those whose ill health comes to light because of contact with the health service. We conclude that, at a small area level, hospital service use is not a particularly useful proxy measure for morbidity, and one that can be used only for a limited range of conditions.

Use of primary care may also reflect morbidity levels. In a study using the Nottingham Health Profile (NHP),^{9,10} Bucquet and Curtis²⁵ found that although social differences in morbidity were not matched by significant social group differences in recent GP consultation behaviour, there were strong statistical associations between consultation and NHP dimensions for physical immobility, social isolation, pain, and emotional distress.

In view of the magnitude of the task of health needs assessment, all routinely available measures that might be a proxy for the health of parts of the population should be examined, and there is a case for greater use of primary care utilisation data. Caution is advised, however, in using hospital service utilisation as a proxy to plan resource allocation without preliminary investigation of its appropriateness for the conditions being studied. The correlation coefficients show that much of the variance between electoral wards remains unexplained and, more importantly, for most conditions hospital service use does not provide even a moderate measure of morbidity. Moreover, there is an indication that, for some conditions, areas with higher prevalence of morbidity actually have lower use of hospital services than those with lower prevalence.

Although both the unemployment rate and Jarman score²⁶ have been found to correlate with use of health services,²⁷ it cannot be assumed automatically that underlying morbidity bears a similar relationship. Although sociodemographic measures have been sug-

gested as a proxy measure for local levels of health,²⁷⁻³³ our earlier work has shown that measures of social deprivation such as Jarman scores¹⁰ and unemployment correlate well only with certain specific areas of ill health.³⁴

In interpreting the present findings it should be remembered that the response rate varied between electoral wards, although all but three wards had a response rate of over 75%, and that this might have influenced the results. Variation in response rate between social groups was also found in the Whitehall study of health inequalities among civil servants³⁵ but is not documented in Curtis's study.³³ Another important consideration is of the heterogeneity within electoral wards in respect of service utilisation. This may reduce the estimate from a ward-based analysis of the real strength of associations present at a smaller area level. Variability in the use of the private sector in electoral ward populations may partly explain some of the lack of correlations. There are no private inpatient facilities in the local district general hospital, however, and the local population is likely to make limited use of the private sector elsewhere. We cannot be absolutely sure that cases were being ascribed to electoral wards within the Trent Regional Patient Information System with 100% accuracy. Local hospitals checked all cases for the presence of a valid postcode before dispatching hospital data, however, and Trent region would not accept data with invalid or missing postcodes. Corrections and updates to the regional computerised postcode directory have been continuously made over the past seven years. Planners, researchers, finance staff, and managers have used the patient information system extensively over this period and found no major cause for concern.

Mortality information, although useful as a proxy for morbidity in many circumstances, is also of little value for the common conditions examined here. This is not surprising in view of the small number of deaths associated with these disorders, although their associated morbidity is considerable.

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